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Critical Reynolds number for global instability of channel flow in subcritical scenario[1] TAKAHIRO ISHIDA, TAKAHIRO TSUKAHARA, Department of Mechanical Engineering, Tokyo University of Science — We perform direct numerical simulations for the transitional pressure-driven channel flow and investigate the critical Reynolds number for global instability ($\mathrm{Re_G}$). In the channel flow, the critical Reynolds number relevant to local (infinitesimal) instability ($\mathrm{Re_L}$) is known as 5772, which is based on the channel half width ($h/2$) and the channel centerline velocity in laminar flow, by the linear stability theory. However, the understanding of $\mathrm{Re_G}$ is still unresolved because it is inherently non-linear. In this study, temporal progress of a turbulent spot that grows from finite disturbance in the laminar flow is analyzed. We use the small and the large computational boxes for identifying the lower critical number, which are $L_x{*}L_y{*}L_z$ =6.4h*h*3.2h and 102.4h*h*51.2h, respectively. For the small box, we determine $\mathrm{Re_G}|_\mathrm{S}$ is 1400. The flow regime observed in the small box is only either laminar flow or fully-developed turbulence. As for the large box, we obtain $\mathrm{Re_G}|_\mathrm{L}$ of 875 because of the emergence of the transitional structure named "turbulent stripe," or a coexistence of oblique turbulent and laminar region. Because the spatial size of turbulent stripe is much larger than the small box, $\mathrm{Re_G}|_\mathrm{S}$ indicates the critical Reynolds number for the flow without large-scale intermittency. Therefore, we found that the existence of turbulent stripe caught in large box would decrease the $\mathrm{Re_G}$ value compared to those proposed by previous studies.

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